Space matters: Reconstructing a Local-scale Okun's Law for Italy

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Abstract **- The present study develops a local-scale analysis of Okun's law for short-term changes in district product and unemployment rate in 686 labour market areas in Italy (2004-2005) based on a Geographical Weighted Regression (GWR) model. The relationship between changes in district product and unemployment rate was poorly significant using both parametric and non-parametric (a-spatial) techniques being more intense when space is incorporated in the model. The GWR results pointed out the spatial patterns characterizing the Okun's law at the local scale. The elasticity of district income to unemployment rate showed important spatial variations being higher in dynamic rural districts around metropolitan areas. The highest model performance was found in specific areas of both northern and southern Italy. However, the classical Okun negative relationship between district product and unemployment rate was mainly observed in northern Italy while the reverse pattern was identified primarily in southern Italian districts. While providing a novel approach shedding light on the spatially-varied income-employment dynamics, GWR models allow evaluating the complex geography of economic growth in Italy. The use of local-scale data and spatial approaches may inform policies regulating job markets on the base of their territorial specificity.**

Keywords *- Economic growth, Unemployment, Travel to work Areas, Geographically Weighted Regression, Italy.*

1. Introduction

Changes in the economic structure of countries and regions are described using long-term spatio-temporal data checking for convergence/divergence over time (Barro and Sala i Martin, 2004) or analyzing territorial disparities through indicators derived from district product, value added, disposal income or unemployment rate (Giannini et al., 1995; Terrasi, 1999; Proietti, 2005; Viesti et al., 2011). The linkage among such indicators is also studied using empirical relationships based on stylized facts, such as the well known Phillips' curve and Okun's law (Layard et al., 1991). Okun's law has implications regarding macroeconomic policies, in particular as regards the determination of the optimal or desirable growth rate of real product (Palley, 1993; Moosa, 1997, 1999). Okun's law consists of an empirical relationship that links changes in the unemployment rate to changes in the growth rates of Gross Domestic Product (GDP). This formulation is derived from a study performed by Okun on the post-war economy of the United States of America (Smith, 1975). The rationale behind Okun's intuition stems from the reflection that the maximum level of wealth of an economic system is determined at full employment (Paldman, 1987). Okun illustrated the existence of an inverse relationship between unemployment and real GDP growth above long-term trends, estimating that the link between the two variables was quantified for the United States with a ratio of 1 to 3 (Kaufman, 1988). The interest on this finding - in addition to being guided by empirical robustness - is due to its theoretical importance because the aggregate supply curve can be determined by the combination of Okun's law and Phillips' curve (Prachowny, 1993).

At the same time, Okun pointed out how some structural changes on the labour market can affect the validity of the estimated function identifying three variables that influence the relationship between changes in the unemployment rate and the real GDP: (i) the degree of participation in the labour market, (ii) the number of hours worked per employee and (iii) labour productivity. Scholars have tried to test the empirical validity of Okun's law in different spatial contexts and time intervals, often highlighting the role of some economic and social components. Some authors (Gordon, 1984; Evans, 1989; Weber, 1995) analyzed the effect of external shocks on the dynamic relationship between real GDP and unemployment. Using the oil shock of the 1970s as a break-even point in the time series analyzed, a loss of intensity in the estimated Okun's coefficient in the

years after 1973 was noted (Harris and Silverstone, 2001). Further studies have suggested that the progressive participation of women in the labour market, the slowdown in productivity and wages, and the process of economic restructuring are relevant factors determining the loss of intensity of the estimated Okun's coefficients (Brunner, 1997; Lee, 2000; Freeman, 2001).

More recent studies have focused on the existence of asymmetry in Okun's relationship (Attfield and Silverstone, 1998). Asymmetry may reflect a different response of unemployment to changes in the growth rate of GDP depending on the economic phase (i.e. expansion or recession). Asymmetry is seen also as a result of the (more or less effective) regulative power of labour markets (Virén, 2001). Rapid economic downturns can have an effect more than proportional on the unemployment rate, also due to the mismatch between supply and demand in relation to sectoral and local labour markets (Silvapulle et al., 2004). Asymmetry in Okun's law would strengthen the theory on the presence of asymmetry even in the Phillips curve (Harris and Silverstone, 2001). A precise assessment of asymmetry in Okun's law and Phillips' curve may be useful to fine-tuned policy measures for structural stabilization and may reduce forecast errors (Balakrishnam and Michelacci, 2001).

Asymmetry can also reflect specific territorial dynamics and regional disparities in local labour markets that cannot be investigated using traditional data at country or regional level. Based on these premises, the local-scale assessment of Okun's law may be meaningful when working in countries with vastly different regional contexts due to the presence of sub-national job markets characterized by economic divides, lack in coordination and intrinsic fragmentation. Italy, with the uneven gap between wealthier northern regions and disadvantaged southern regions, is a potentially interesting case to evaluate the influence of the territorial component on Okun's relationship (Virén, 2001).

The present study illustrates an original approach verifying the short-term validity of Okun's law in Italy at the local scale in 686 labour market districts, taken as homogeneous spatial unit relevant from the economic point of view. The objective of this analysis is to focus on territorial dynamics reducing simultaneously the effect of asymmetry. District income is expressed through computation of value added at various geographical levels. The relevance of the used spatial unit can be assessed based on the peculiarity of the administrative system enforced in each country and the developmental policies that are targeted to improve income levels.

Indicators at local district level are being increasingly diffused according to the availability of digital statistical data and ancillary information from other official sources (Salvati and Sabbi, 2014). These indicators usually provide a more detailed picture of the geography of wealth and economic development of a certain region or country that more traditional regional estimates (Patacchini, 2008). Investigating short-term spatial patterns of product and unemployment in an economically-divided country like Italy provides insight in the analysis of local labour market regulation in the light of full employment and territorial disparities reduction.

2. Methodology

2.1. Study area

The whole Italy (301,330 km^2) was considered as the study area. A total of 686 Local Labor Market Area (LLMA) districts, reflecting homogeneous areas from the economic perspective at an enough detailed geographical scale, were considered as the analysis spatial unit (Salvati et al., 2011). LLMA districts were defined by the Italian National Statistical Institute (Istat) according to data collected in 2001 National Census of Population and Households (Istat, 2006).

2.2. Indicators

Data on district product and unemployment rate at the LLMA level have been provided by Istat for the years 2004 and 2005. Annual averages for these indicators were based respectively on elaboration on (i) the system of national/regional accounts and (ii) microdata of the Labour Force Survey. A vector map of LLMA districts provided by Istat (2006) was used to prepare thematic maps illustrating the spatial distribution of percent change in district product and unemployment rate in Italy.

2.3. Data analysis

To explore the pair-wise relationship between percent changes of district income and unemployment rate on the district scale in Italy, both parametric (Pearson moment) and non-parametric (Spearman rank) correlation coefficients were carried out testing for significance at $p < 0.05$. A linear a-spatial model was used to estimate the Okun's relationship based on the following equation:

$$\Delta y_{it} = \beta_0 + \beta_1 \Delta x_{it} + \varepsilon_{it} \quad (1)$$

where y_{it} is the product for the *i*-th district at time t, x_{it} is the value of the unemployment rate, while Δ indicates the difference-over-time operator (2004-2005 in the present case) and ε is a white noise disturbance term. β_0 estimates the intercept of the model and captures the average growth rate of the dependent variable. Elasticity between percent change in district product and unemployment rate was calculated at the district scale to illustrate the spatial asymmetry in Okun's relationship in Italy.

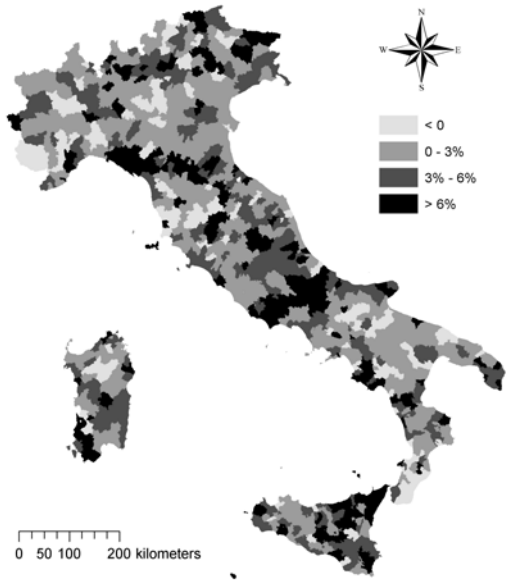
Based on the existence of spatial dependence in both variables, the Geographically Weighted Regression (GWR) framework proposed by Fotheringam et al. (2002) was used to identify the effect of spatial asymmetry in local labour markets incorporating the spatial structure of the distribution of product and unemployment rates in the Okun's law. The methodological framework underlying GWR is similar to that of local linear regression models, as it uses a kernel function to calculate weights for the estimation of local weighted regression models. Contrary to the standard regression model, where the regression coefficients are location invariant, the specification of a basic GWR model for each location s = 1, …, n, is:

$$\Delta y_t(s) = b_0(s) + b_1 \Delta x_t(s) + \varepsilon_t(s) \quad (2)$$

where $\Delta y_t(s)$ is change in district product at location s, X(s) is change in unemployment rate at location s, $b_1(s)$ is the column vector of regression coefficients at location s, $b_0(s)$ is the column vector of regression intercepts at location s and $\varepsilon(s)$ is the random error at location s. Hence, regression parameters, estimated at each location by weighted least squares, vary in space, implying that each coefficient in the model is a function of s, a point within the geographical space of the study area. As a result, GWR gives rise to a distribution of local estimated parameters, modeling socioeconomic processes that are non-stationary in space (Salvati et al., 2011). The weighting scheme is expressed as a kernel function that places more weight on the observations closer to the location s. In this study, we adopted one of the most commonly used specifications of the kernel function, which is the bi-square nearest neighbour function. The outputs of GWR model were illustrated using maps (local R^2, β_1 coefficient, β_0 intercept and regression residuals).

3. Results and discussion

The spatial distribution of short-term percent change in district product and unemployment rate in 2004-2005 is illustrated in Figure 1. Maps indicated a quite heterogeneous pattern for both variables with district product expanding the most in rural districts surrounding metropolitan areas in both central and northern Italy. Also some marginal, disadvantaged districts grew at a rate above the country average. Short-term gains in employment rates were mainly observed in rural, internal districts of central Italy with a more scattered pattern in both northern and southern Italy.



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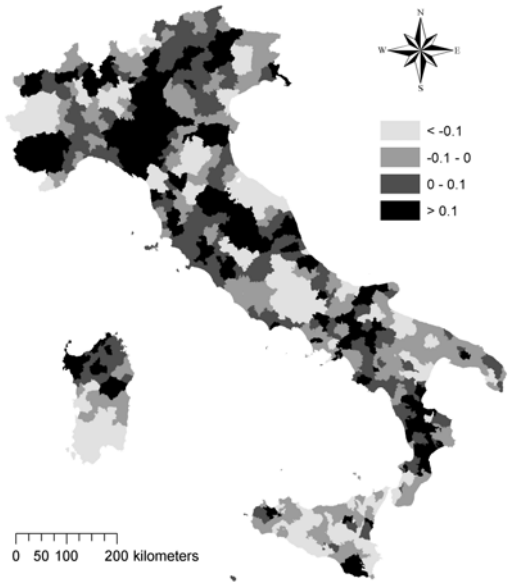

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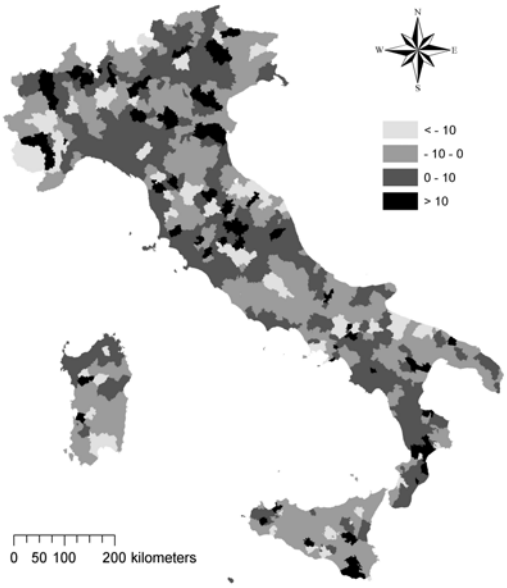

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Figure 1. Maps illustrating the spatial distribution of (a) percent change in district product (b), percent change in unemployment rate and (c) elasticity between district product and unemployment rate.

The elasticity between percent growth in district product and unemployment rate shows a heterogeneous spatial pattern: highly positive elasticity values (indicating unemployment increases with product expansion) were scattered across Italy especially in northern and central districts. Highly negative elasticity values (indicating employment increases with product expansion) were found in a discontinuous pattern in rural areas in both central and southern Italy with few cases observed also in northern Italy. The spatially-varying elasticity score indicates that the two variables are space-dependent.

Figure 2 illustrates descriptive statistics on the relationship between percent changes in district product and unemployment rate in Italy. Both variables show a quasi-normal distribution and a general trend toward a moderate, negative correlation identified in both parametric field ($r = 0.107$, $p < 0.01$, $df = 685$) and non-parametric field ($r_s = 0.104$, $p < 0.01$, $n = 686$). Based on the linear model (1), the estimated regression coefficient for percent change in district product in Italy is -0.028 with 0.033 intercept. The intercept coincides with the average growth rate of district product; the regression coefficient is relatively lower than the values observed in the classical post-war studies (Smith, 1975; Gordon, 1984; Kaufman, 1988; Evans, 1989; Palley, 1993) dealing with Okun's relationship (ranging between -0.2 and -0.3) and closer to values recorded for recent decades (Lee, 2000; Freeman, 2001; Harris and Silverstone, 2001).

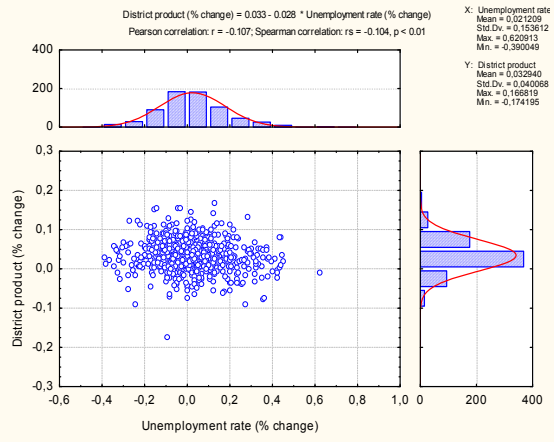
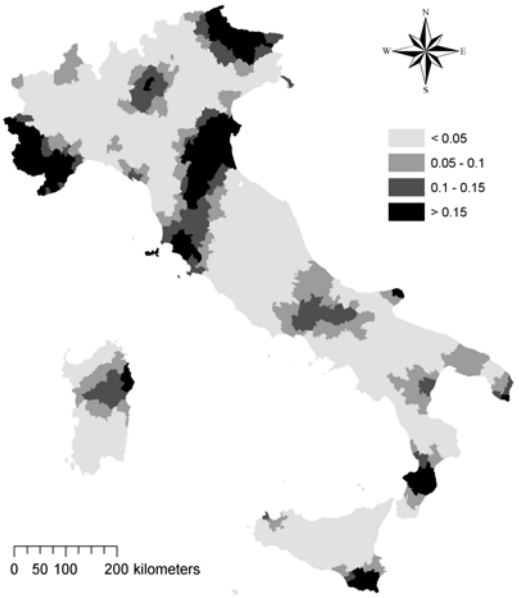


Figure 2. The relationship between district product (% change) and unemployment rate (% change) in the 686 Italian district between 2004 and 2005.

The results of GWR applied to the local-scale Okun's relationship in Italy are illustrated in Figure 3. The adjusted R^2 of the GWR was 0.213 for the whole of Italy and local R^2 represents a spatial heterogeneous pattern with few districts - concentrated in Piedmont, Lombardy, Friuli, Emilia Romagna, Tuscany and Calabria regions - showing local R^2 above the country average (Figure 3a). In these areas the relationship between district product and unemployment rate is more intense as clearly indicated by the local estimates of β_1 regression coefficient (Figure 3b). Local coefficients below -0.1 (approaching the classical values observed for Okun's relationship in post-war developed economies) are concentrated in Friuli, Lombardy, Emilia Romagna, Tuscany and, in part, northern Sardinia and inland districts of Campania where high R^2 scores were also observed. In these districts, Okun's relationship was more intense and negative suggesting that local labour markets are more sensitive to measures for local development and unemployment reduction. Apart from few exceptions, local labour markets in these regions are characterized by medium-low unemployment rate and medium-high participation rate compared to the rest of Italy. Districts with intense relationship between the two variables (high local R^2) and positive β_1 coefficients (indicating an inverse Okun's relationship) are concentrated in southern Italy (districts in Calabria, south of Campania and Apulia).



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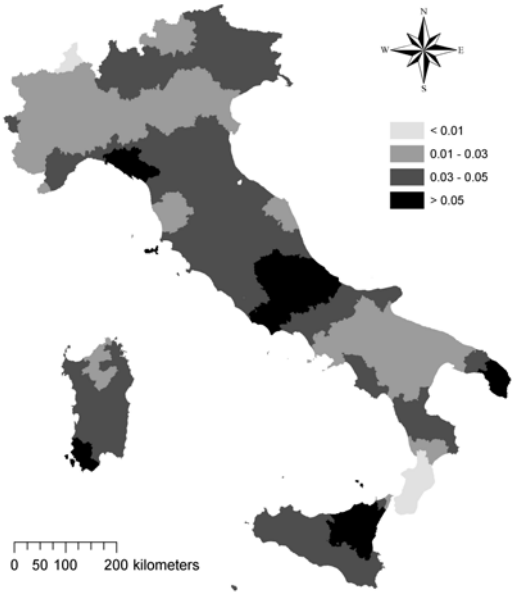

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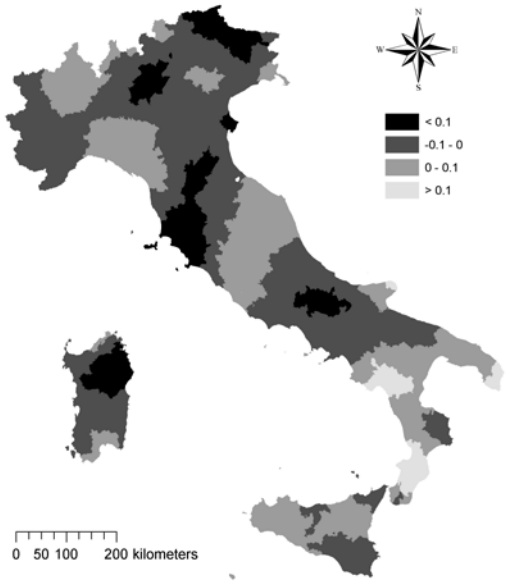

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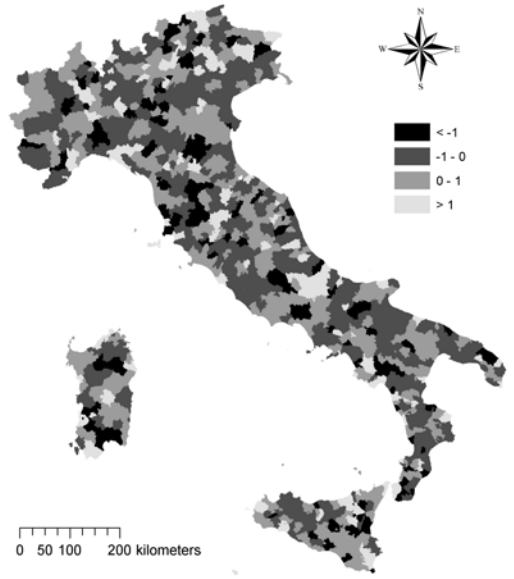

(d)

Figure 3. Maps illustrating the outcomes of the Geographically Weighted Regression model applied to the relationship between local product and unemployment rate in the 686 Italian districts (2004-2005): (a) local R^2 (b), β_1 coefficient, (c) β_0 intercept, (d) model's residuals.

Positive coefficients confirm the spatial asymmetry that may influence the overall relationship at the national scale and are possibly due to persistently high values of unemployment rate. The spatial pattern of GWR local intercepts reproduces substantially the expansion (or decline) in district product being quite uncorrelated with local β_1 coefficients. Finally, the spatial pattern of regression residuals is typically scattered across the country with no explicit spatial structure.

4. Conclusions

The present study provides insights in the local-scale Okun's relationship between district income and unemployment rate in Italy. Asymmetry and regional disparities in income and labour market performances were found as relevant factors influencing short-term Okun's relationship in a divided country such as Italy (King et al., 2001; Dunford and Greco, 2007; Viesti et al., 2011). A moderate coefficient was observed for the negative relationship between changes in district product and unemployment rate. However, the relationship became more intense and significant when incorporating space in the regression model. The different conditions of the labour market, distinguishing between northern-central regions and southern regions in terms of both participation and unemployment rate may be considered a powerful factor determining asymmetry in Okun's relationship.

The outcomes of GWR model reflect the spatial variability observed in both the dependent and the independent variables indicating a different intensity in the relationship among district income and unemployment rate. Higher negative coefficients, closer to what Okun found for US economy (e.g. Attfield and Silverstone, 1998), were observed especially in northern and central Italy districts being associated to a local R^2 above the national average. Positive and significant coefficients were also found in some districts especially in southern Italy indicating asymmetry and the structural mismatch between supply and demand in local labour markets reflected into high unemployment rates. In the majority of Italian districts, the relationship between the two studied variables showed moderate (or low) negative coefficients and moderate (or low) local R^2. Together with the analysis of spatial elasticity between district product and unemployment rate, these outcomes clearly reveal the high fragmentation of local labour markets in Italy at the base of differential Okun's relationships between northern-central and southern areas of the country. The analysis underlines the different impact of policies stimulating local development in districts exhibiting distinct short-term responses to unemployment rate based on product expansion or decline.

Policy implementation depend on the mutual interactions among the drivers of economic development acting differently at the various relevant geographical scales (Layard et al., 1991). Indicators made available on high-resolution spatial units and spatial statistical techniques can be successfully applied to the study of regional economic performances and territorial disparities providing insight for improved policies promoting local development. Local labour market districts show appreciable features that fill the need for data integration, reliability and relevance to regional issues. Our results definitely indicate that a stronger integration between economic indicators is required to achieve a more comprehensive, comparative picture of local production structures and performances affecting country-scale peculiar trends.

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